

1 **Wireless Security, Telemetry and Control System**

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3 **FIELD OF THE INVENTION**

4 This invention relates to a combination security,
5 telemetry and control system for mobile equipment such as
6 vehicles, construction machinery, agricultural equipment or
7 material handling units. A vehicle mounted main control unit
8 provides wireless bi-directional communication with smart
9 relays located within the vehicle and a remote base/control
10 station located outside of the vehicle.

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12 **BACKGROUND OF THE INVENTION**

13 Theft and unauthorized use of mobile pieces of equipment
14 such as motor vehicles, construction equipment, aircraft and
15 the like is widespread. Vehicle security systems are widely
16 used to deter vehicle theft and vandalism, prevent theft of
17 valuables from a vehicle, and to protect vehicle owners and
18 occupants. A typical automobile security system includes a
19 central processor unit (CPU) or controller connected by wire
20 to a plurality of vehicle sensors. Typical sensors that
21 monitor the vehicle may detect opening of the trunk, hood,
22 doors or windows. Other common sensors such as ultrasonic
23 and microwave motion detectors, vibration sensors, sound
24 discriminators, and differential pressure sensors may detect

1 movement of the vehicle or within the vehicle. Still other
2 sensors such as radar sensors may be used to monitor the area
3 proximate to the vehicle. Any number of these sensors may be
4 hard wired to the controller unit and may trigger the alarm
5 when a thief violates a protected area.

6 A vehicle security system may also include a passive
7 arming feature wherein the status of all trigger inputs are
8 automatically monitored when the ignition switch is turned
9 off. Normal arming occurs after expiration of an exit delay.
10 U.S. Pat No. 4,754,255 to Sanders et al. discloses a
11 variation of passive arming wherein any unsecured zone is
12 monitored when the ignition key is turned off.

13 Although numerous devices are well known, they have
14 generally met with limited success and share numerous
15 weaknesses. For most alarm systems, it is desirable to hide
16 the location of the controller and sensors to prevent a thief
17 from discerning their location and defeating their operation.
18 Unfortunately, installation of the prior art devices
19 generally require installers to run new wiring. Extra wiring
20 is a tell tale sign to thieves that a security system is
21 being employed. The extra wiring also provides a weak link
22 in the alarm system, giving away the controller and sensor
23 hiding places which are easily disabled by cutting the wires
24 that connect the system.

1 When a vehicle sensor is triggered, the security systems
2 currently available typically operate to give an alarm
3 indication. The alarm indication may be a flashing of the
4 lights and/or the sounding of a horn or a siren. In
5 addition, the vehicle fuel supply and/or ignition power may
6 be selectively disabled based upon the alarm condition.

7 Unfortunately, flashing lights, horns, and sirens are
8 extremely common today and rarely provide an efficient
9 deterrent to thieves. Radio signaling systems are likewise
10 ineffective because they rely on the speed and efficiency of
11 local police departments. Many police departments are
12 understaffed and unable to respond before a thief can gain
13 enough knowledge about an alarm system to disable it.

14 In an attempt to eliminate the tell tale extra wiring,
15 other alarm systems utilize the existing vehicle wiring
16 harness. A system that connects to the existing wiring
17 harness and on-board computer system is disclosed in U.S. Pat
18 No. 5,473,200. These systems have also proven to be
19 ineffective and obvious to more sophisticated thieves with
20 access to electronic equipment. Today most vehicles and/or
21 engine equipped machinery have a self-diagnosing control
22 system or on-board computer. When starting the vehicle the
23 on-board computer checks to see that all critical systems are
24 operational. If a system is not functioning properly a

1 warning light or signal is activated to alert the operator of
2 the non-functioning system. For example, if a security
3 system disables the fuel circuit the on-board computer will
4 illuminate a dash light and store a code in the computer.
5 Knowledge about the system can be easily gained visually or
6 with equipment such as an engine scanner, which a thief can
7 use to disable the alarm system.

8 It is also known to provide remote communication with
9 certain operable circuits or functional elements of a vehicle
10 through the security system. A typical security system of
11 this type includes a receiver associated with the controller
12 that cooperates with a remote transmitter such as an
13 electronic key fob carried by the user, such as those
14 disclosed in U.S. Pat. No. 4,383,242 to Sassover et al., and
15 No. 5,049,867 to Stoufer, and No. 5,146,215 to Drori. The
16 remote transmitter may be used to arm and disarm the
17 controller in the vehicle or provide other remote control
18 features from a predetermined range directly outside the
19 vehicle. The controller may contain features to store and
20 compare unique codes associated with a plurality of remote
21 transmitters, each remote transmitter having its own unique
22 code initially programmed therein. Transmitter codes may be
23 added or deleted from the controller corresponding to the
24 number of remote transmitters desired by the user.

1 Unfortunately, a thief may use a signal scanner to gain
2 access to the controller and readily install the code of an
3 unauthorized remote transmitter. The owner would thus be
4 unaware of such activity, until the thief returns with the
5 unauthorized remote transmitter to disarm the security system
6 and steal the vehicle.

7 U.S. Pat. Nos. 5,990,785 and 6,262,656 disclose security
8 systems that are capable of disabling a vehicle using pager
9 networks or cell phones. However, these systems suffer from
10 some of the same shortcomings as those discussed above. The
11 controllers require hardwiring throughout the vehicle,
12 allowing a sophisticated thief to cut wires to disable the
13 system. Moreover, the systems do not transmit a tracer
14 signal when the vehicle is stolen or utilize monitoring from
15 a base station. To disable the vehicle the owner must know
16 the vehicle has been stolen and be physically able to call
17 the system to input the code which initiates the disabling
18 sequence. These systems are inadequate for vehicles parked
19 in remote areas not driven daily as days may pass before the
20 owner would realize the vehicle was missing. Moreover, these
21 systems do not provide any method of monitoring temperatures,
22 pressures, loads or speeds from a base station during normal
23 vehicle operation.

24 The aforementioned problems with known security systems

1 are exacerbated when used on expensive heavy construction
2 machinery and agricultural equipment that often remains in
3 very remote areas for extended periods of time. The high
4 value and remote location of the equipment increase the
5 likelihood of theft and make it impossible to monitor a
6 typical flashing light and siren alarm. Even if alerted,
7 police may find it difficult or impossible to locate or gain
8 access to the equipment before a thief can abscond with it.
9 Typical alarms alert the thief, giving him time to escape
10 from the area before the authorities can get there. Some
11 thieves may return multiple times with different electrical
12 equipment or strategy attempting to bypass or disable the
13 system.

14 In addition to preventing theft of their equipment, some
15 equipment owners or businesses may want to monitor the normal
16 usage and operating condition of their equipment from a base
17 station using wireless communication. Prior art security
18 systems generally do not offer the ability to telemeter such
19 items as pressures, temperatures and speeds related to the
20 equipment. It would also be beneficial for vehicle owners to
21 control functions such as locking, unlocking, disabling and
22 starting of this equipment from the base station using
23 wireless communication. Accordingly there has been a long
24 felt need in the art for a combination security, telemetry

1 and control system which provides an efficient deterrent to
2 crime as well as providing valuable information to equipment
3 owners.

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1 SUMMARY OF THE INVENTION

2 In view of the foregoing background, it is an objective
3 of the present invention to provide a security system which
4 utilizes wireless communication between a control unit and
5 smart relay(s) to protect a vehicle, or piece of equipment,
6 against unauthorized users and thieves.

7 It is a further objective of the present invention to
8 provide a security system which utilizes wireless
9 communication between a control unit and smart relay(s) that
10 is hidden from vehicle diagnostic equipment.

11 It is another objective of the present invention to
12 provide a security system which utilizes wireless
13 communication between a control unit and smart relay(s)
14 capable of sending out a tracer signal in the event the
15 protected vehicle or heavy equipment is tampered with.

16 It is yet another objective of the present invention to
17 provide a security system which utilizes wireless
18 communication between a control unit and a remote base
19 station which allows the vehicle or equipment to be monitored
20 from remote locations via wireless networks.

21 It is a further objective of the present invention to
22 provide a security system kit which is simple to install and
23 suited for original equipment and after market installations
24 on mobile vehicles and heavy equipment.

1 Yet another objective of the present invention is to
2 provide a security system kit which is inexpensive to
3 manufacture and which is simple and reliable in operation.

4 Other objectives and advantages of this invention will
5 become apparent from the following description taken in
6 conjunction with the accompanying drawings wherein are set
7 forth, by way of illustration and example, certain
8 embodiments of this invention. The drawings constitute a
9 part of this specification and include exemplary embodiments
10 of the present invention and illustrate various objects and
11 features thereof.

12 In one embodiment of the instant invention the system
13 utilizes a wireless communication network between the main
14 control unit (MCU) and smart relays to replace the
15 conventional hard-wired controller and sensor systems of the
16 prior art. The instant invention also provides a reporting
17 alarm, telemetry and control system which utilizes a two-way
18 paging device and/or a two way cellular data modem to
19 communicate between the main control unit and a remote base
20 monitoring station. Equipment such as mobile vehicles,
21 construction machinery, agricultural equipment or material
22 handling units incorporate the MCU and at least one smart
23 relay in wireless communication with the MCU for indicating
24 an alarm condition or monitoring vehicular parameters. The

1 MCU includes at least one receiver for receiving commands
2 from the base station via the two-way pager or cellular data
3 modem devices and may include an optional RF, low frequency
4 or infra red receiver for checking the user ID and receiving
5 information from the smart relay(s). The user ID may be
6 checked via the wireless two-way pager device or a
7 programmable electronic key which transmits the user ID to a
8 surface mounted receiver. The MCU collects and processes
9 various alarm conditions and/or vehicular operating data via
10 sensors incorporated into the smart relay(s) which can be
11 stored in memory or transmitted to the remote base station
12 via the 2-way paging or cellular device. For example sensors
13 are available for incorporation into the smart relay for
14 monitoring operating characteristics such as temperature,
15 pressure, load monitoring, flow rates, speeds, electrical
16 system status, servicing needs, as well as alarm conditions
17 such as opening of the trunk, hood, doors and windows.
18 Movement of the vehicle, within the vehicle or around the
19 vehicle may also be monitored using ultrasonic and microwave
20 motion detectors, vibration sensors, sound discriminators,
21 differential pressure sensors, and radar sensors. The data
22 transferred to the remote monitoring station can be further
23 analyzed and statistically compared to trend data to further
24 ascertain the condition and operating parameters of the

1 equipment. Upon receipt of anomalous data or an alarm
2 condition from a smart relay, the base station can transmit
3 commands back to the MCU. The MCU includes at least one
4 transmitter for transmitting commands to the smart relay(s).
5 Such commands would permit the base station to remotely
6 control or alter functions of the vehicle and the security
7 system; for example, allowing the vehicle to start without
8 the proper ID key, controlling fuel supplied to the engine,
9 shutting down the equipment or specific systems.

10 Accordingly, an existing low-cost bi-directional pager
11 and/or cellular transmission network can be utilized.
12 Whereas prior paging technology only allowed for one-way
13 paging, current two-way pager systems allow transmissions to
14 be sent in both directions between the base station and the
15 MCU. Known communication protocols and data structures can
16 be used to facilitate the organization and transmission of
17 data and/or commands. The two-way pager device and related
18 protocol might include any of several systems currently on
19 the market. For example, Motorola's Advanced Messaging
20 Systems Division (AMSD) and Destineer Corporation, which is a
21 subsidiary of Mobile Telecommunication Technologies Corp.
22 (Mtel), provide a nationwide ReFlex.TM system.

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BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a block diagram of a security system utilizing the two-way paging device to communicate between a vehicle and a base station;

Figure 2 is a block diagram of the wireless smart relay of the instant invention;

Figure 3 is a block diagram of an alternative embodiment of the instant invention.

1 DETAILED DESCRIPTION OF THE INVENTION

2 Although the invention is described in terms of a
3 preferred specific embodiment, it will be readily apparent to
4 those skilled in this art that various modifications,
5 rearrangements and substitutions can be made without
6 departing from the spirit of the invention. The scope of the
7 invention is defined by the claims appended hereto.

8 Referring to FIG. 1, a block diagram of the instant
9 invention is shown illustrating the preferred system 10 which
10 would be installed into a piece of mobile equipment, e.g.
11 vehicle, construction machinery, farm equipment, airplane,
12 boat, material handling equipment and the like, and linked
13 via a wireless two-way pager and/or cellular connection to a
14 remote base monitoring station 30. The equipment is
15 protected by the security system 10 which incorporates the
16 two-way paging device 14 in the security system main control
17 unit 12. The base monitoring station 30 utilizes a computer
18 32 coupled to a similar two-way paging transmitter/receiver
19 34. During normal operation or an alarm situation within the
20 vehicle, coded transmissions emanate from the respective
21 antenna 16 which is electrically connected to the two-way
22 paging device 14. The coded messages are received by the
23 base station antenna 36 which is electrically connected to
24 the base two-way paging device 34. The messages may be read

1 directly from the two-way pager device 34 or they may be
2 input into the computer 32 for storage or further analysis.
3 As described above the two-way pager system might include
4 hardware and related protocol software from any of a variety
5 of manufacturers. The preferred embodiment presented herein
6 utilizes the ReFlex.TM communication protocol for its
7 functionality.

8 The MCU 12 includes a wireless transmitter and receiver
9 for communicating with at least one smart relay which
10 monitors and/or controls some parameter of the vehicle. The
11 transmitter and receiver may be an RF, low frequency or
12 infra-red type or a suitable combination thereof. The
13 wireless communication between the main control unit 12 and
14 the smart relay(s) 20 of the system allow the components to
15 be discretely hidden within the vehicle without tell-tale
16 wiring and at locations unfamiliar to thieves.

17 The MCU 12 also includes a means of establishing a user
18 ID which is preferably a combination electronic key 18 and a
19 electronic key receiver 19. The electronic key 18 has a
20 unique and unalterable address laser etched onto the chip
21 which can be used as an identifier for each key. The
22 features available to each of the electronic keys 18 are
23 programmable with a PC, a laptop or a hand held computer to
24 enable or disable any number of functions within the

1 equipment configured with a smart relay 20. The key 18 can
2 be of the read only memory (ROM) type which allows the key to
3 be programmed only once, or they can have a re-programmable
4 type memory allowing the key to be reprogrammed to accept
5 additional equipment or functions. The electronic key 18 can
6 also be programmed to control the hours of operation for a
7 piece of equipment or to allow operation of numerous types
8 and/or pieces of equipment with a single electronic key. The
9 key receiver 19 is also programmable to accept a plurality of
10 electronic keys 18, and in the preferred embodiment should
11 accept about twenty different keys. Each key 18 is operable
12 to control any number of the available features or functions
13 associated with the piece of mobile equipment. Such an
14 electronic key is currently sold under the name iButton by
15 Maxim/Dallas Semiconductor Corporation. It is also
16 understood that other suitable electronic key devices such as
17 magnetic strips, computer chips and key fobs, as well as
18 combinations thereof could be utilized to establish a user ID
19 with the MCU 12.

20 Referring again to FIG. 1, and operation of the
21 preferred embodiment of the instant invention. The operator
22 turns on the ignition key and thereafter establishes a user
23 ID by touching his electronic key 18 to the electronic key
24 receiver 19 in electrical communication with the MCU 12. The

1 user ID code is transferred from the electronic key 18 to the
2 MCU 12 via the key receiver 19. The MCU 12 thereafter
3 enables the functions of the mobile piece of equipment
4 permitted by the user ID. If the ID code is correct the MCU
5 12 transmits the "allow start" command to the smart relay 20
6 to permit the vehicle or heavy equipment to start. In the
7 event that an operator loses an electronic key 18 or someone
8 needs to operate a piece of equipment that does not have an
9 electronic key 18, the base station 32 can utilize the two-
10 way pager or cellular device 34 to enable the system 10 and
11 allow the equipment to operate. If no electronic key is used
12 or the incorrect electronic key is touched to the receiver 19
13 the MCU 12 can be programmed to disable functions such as
14 starting or fuel supply, or enable functions such as sending
15 an alert or tracer signal to the base station 32 or
16 activating a siren and lights (not shown).

17 Referring now to FIG. 2, a more detailed block diagram
18 of the wireless smart relay 20 is shown. The smart relay
19 includes three basic components: the local control unit (LCU)
20 22, the communication unit 24, and a relay unit 28 and may
21 include a sensing unit 26 and/or a start detector unit 29 as
22 optional components.

23 The LCU 22 coordinates the various functions and modes
24 of the smart relay components to allow the smart relay 20 to

1 function as a single unit in communication with and
2 controlled by the MCU 12.

3 The communications unit 24 is constructed and arranged
4 for wireless communication with the MCU 12. The
5 communications unit 24 includes an RF, low frequency or
6 infra-red receiver for receiving wireless commands from the
7 MCU 12 and may also include an optional RF, low frequency or
8 infra-red transmitter to send information collected by the
9 smart relay 20 back to the MCU 12 when required.

10 The optional sensing unit 26 is constructed and arranged
11 to monitor a variety of items related to the equipment which
12 may include but should not be limited to electrical system
13 status, speed, temperature, fluid levels, pressures, flows,
14 service needs, opening of the trunk, hood, doors, windows,
15 and also movement of the vehicle or within and around the
16 vehicle utilizing ultrasonic and microwave motion detectors,
17 vibration, sound discriminators, differential pressure, and
18 radar. The sensing unit 26 uses state of the art analog or
19 digital sensors and communicates the information back to the
20 LCU 22 in a digital format.

21 The relay unit 28 is constructed and arranged to shut
22 down or turn on functions within the vehicle. The relay unit
23 28 may be either normally open or normally closed based on
24 commands from the LCU 22. This construction allows the smart

1 relay 20 to control the starter, fuel and other vehicular
2 circuits while remaining undetectable by automotive scanners
3 and diagnostic equipment, including the on-board computer as
4 will be discussed further.

5 The optional start detector unit 29 is constructed and
6 arranged to monitor the current operating parameters of the
7 mobile vehicle. This includes monitoring the vehicle for
8 attempted starts as well as preventing a function or system
9 from shutting down at an inopportune time and causing an
10 unsafe condition. If an alarm condition is established by
11 either the sensing unit 26 or the remote base station 30 the
12 LCU 22 will communicate with the start detector 29 to
13 determine if a safe condition exists to complete shut down of
14 that function or system. For example, this arrangement can
15 prevent vehicle systems from being shut down when they are
16 under a load or operating at high speeds, thereby insuring
17 the safety of the operator.

18 The four basic components of the smart relay 20 are
19 capable of operation in three different modes; basic, smart
20 and sensing. In the basic mode, the LCU maintains the relay
21 unit 28 in the normally open position. For example, if the
22 relay unit is incorporated into the starter circuit of the
23 vehicle the equipment will not start until the MCU 12 sends
24 an "allow start" signal to the LCU 22 and the LCU 22 closes

1 the relay 28.

2 In the smart mode, the LCU 22 maintains the relay 28 in
3 the normally closed position wherein the functions of the
4 vehicle will attempt to start normally. When the relay unit
5 28 is in the smart mode the optional start detector 29
6 monitors the vehicle for attempted starts. Upon a sensed
7 attempted start the LCU 22 will automatically open the relay,
8 preventing the start, unless the MCU 12 transmits a "close
9 the relay" command to the LCU after checking the user ID. If
10 the MCU 12 returns the "close the relay" command the relay
11 remains closed and the vehicle function is allowed to start.
12 If the wrong code is returned the relay 28 is opened, thereby
13 preventing the function from completing the starting cycle.
14 If the wrong user ID code is found the MCU 12 may utilize the
15 two-way pager or cellular device 14 to send an alarm code to
16 the base station 30. Thereafter, the base station 30 may
17 send codes back to the MCU 12 to disable specific functions
18 of the vehicle, or the base could return an allow function
19 code to enable the vehicle function. In this mode the smart
20 relay 20 is hidden from diagnostic equipment and the on-board
21 computer. The relay unit 28 operates to disable the vehicle
22 function only during the attempted start and returns the
23 system to normal as soon as the ignition key is released.
24 This prevents an error code from being established within the

1 vehicles on-board computer or any external diagnostic
2 equipment which may be attached to the vehicle, thereby
3 hiding the security system.

4 In the sensing mode the sensor unit 26 can be utilized
5 to monitor a variety of functions inside or outside of the
6 vehicle. Information suitably collectable by state of the
7 art sensors may include but should not be limited to
8 temperature, pressure, load monitoring, flow rates, speeds,
9 electrical system status, as well as alarm conditions such as
10 opening of the trunk, hood, doors and windows. Movement of
11 the vehicle, within the vehicle or around the vehicle may
12 also be monitored using ultrasonic and microwave motion
13 detectors, vibration sensors, sound discriminators,
14 differential pressure sensors, and radar sensors. The
15 measured data is transferred digitally to the LCU 22 which
16 transmits the monitored data to the MCU 12 via the
17 communication unit 24. The MCU 12 may be configured to store
18 and/or optionally transmit the monitored information to the
19 base station via the 2-way pager 14. At the remote base
20 station 30 the information can be further analyzed on a
21 computer 32 and statistically compared to trend data to
22 further ascertain the condition and/or status of the
23 equipment.

24 Referring to FIG. 3, an alternative embodiment of the

1 security, telemetry and control system is illustrated wherein
2 the two-way pager 14 is incorporated into the smart relay 20.
3 This configuration allows the base station 30 to send and
4 receive information directly from the smart relay 20 and
5 return commands directly to the smart relay 20. In this
6 manner the mobile piece of equipment can be monitored and
7 controlled from the base station 30 without the MCU 12. This
8 alternative embodiment system may also be configured to
9 require the equipment user to call or page the base station
10 30 and request for the equipment to be enabled before use.
11 The base station 30 could then enable all or portions of the
12 equipment utilizing the two-way pager devices 34 and 14.

13 All patents and publications mentioned in this
14 specification are indicative of the levels of those skilled
15 in the art to which the invention pertains. All patents and
16 publications are herein incorporated by reference to the same
17 extent as if each individual publication was specifically and
18 individually indicated to be incorporated by reference.

19 It is to be understood that while a certain form of the
20 invention is illustrated, it is not to be limited to the
21 specific form or arrangement herein described and shown. It
22 will be apparent to those skilled in the art that various
23 changes may be made without departing from the scope of the
24 invention and the invention is not to be considered limited

1 to what is shown and described in the specification.

2 One skilled in the art will readily appreciate that the
3 present invention is well adapted to carry out the objectives
4 and obtain the ends and advantages mentioned, as well as
5 those inherent therein. The embodiments, methods, procedures
6 and techniques described herein are presently representative
7 of the preferred embodiments, are intended to be exemplary
8 and are not intended as limitations on the scope. Changes
9 therein and other uses will occur to those skilled in the art
10 which are encompassed within the spirit of the invention and
11 are defined by the scope of the appended claims. Although
12 the invention has been described in connection with specific
13 preferred embodiments, it should be understood that the
14 invention as claimed should not be unduly limited to such
15 specific embodiments. Indeed, various modifications of the
16 described modes for carrying out the invention which are
17 obvious to those skilled in the art are intended to be within
18 the scope of the following claims.

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